
Statistical Notes

These notes define the country groupings and variables employed in the Statistical Tables, identify the sources of information, and explain the methods of handling data. A primary aim is to inform the reader of the main qualifications to the data, much of which is not as accurate and reliable as uniform presentation in statistical tables may imply. This is particularly true of the data on military expenditures, armed forces, and arms transfers, which in many countries are subject to severe limitations of incompleteness, ambiguity, or total absence due to governmental secrecy.

Coverage and Groups of Countries

The statistical tables report data for 172 countries (167 in 1997), including most members of the United Nations as well as non-members Switzerland and China--Taiwan. UN members not covered are generally small and not considered militarily significant; relevant data for them are frequently unavailable.¹

Countries are grouped into normally defined *geographical regions* with the following exceptions: Egypt is assigned to the Middle East rather than to Africa; and Oceania includes only Australia, New Zealand, Papua New Guinea, and Fiji. Note the following redefined and new regions beginning with *WMEAT 1993-1994*: Mexico has been combined with Canada and the United States to form *North America* in the "NAFTA" sense; *Central America, and the Caribbean* and *South America* replace Latin America; *Central Asia and the Caucasus* contains eight republics from the former Soviet Union (since 1992); *Western Europe* consists of NATO Europe plus Austria, Finland, Ireland, Malta, Sweden, and Switzerland; *Eastern Europe* contains the former Warsaw Pact countries plus Albania and the successors to Yugoslavia and the Soviet Union, except those republics from the latter that are detached to Central Asia and Caucasus. A full listing of specific countries in each region may be found in Main Statistical Table III (pages ?-?).

The following political and economic groups are included: NATO, the (former) Warsaw Pact, OPEC, and

OECD. *NATO (North Atlantic Treaty Organization)* consists of Belgium, Canada, Denmark, France, West Germany, Greece, Iceland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Turkey, the United Kingdom, and the United States. Spain, which joined in 1982, has been included in the NATO grouping since *WMEAT 1991-1992*. France also limits its military participation (since 1966), but is traditionally associated with NATO. The *Warsaw Pact*, formally dissolved on July 1, 1991, consisted of Bulgaria, Czechoslovakia, East Germany, Hungary, Poland, Romania, and the Soviet Union. *OPEC (Organization of Petroleum Exporting Countries)* includes Algeria, Gabon, Indonesia, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, the United Arab Emirates, and Venezuela. *OECD (Organization for Economic Cooperation and Development)* comprises the NATO countries and Australia, Austria, Czech Republic, Finland, Hungary, Ireland, Japan, Mexico, New Zealand, Sweden, and Switzerland.

The 33-country *developed* group was revised in the 1995 edition (primarily on the basis of GNP per capita) by shifting the Czech and Slovak Republics, Greece, Israel, Singapore, South Korea, and Taiwan from the developing group to the developed, and Romania from developed to developing. The developed group in this edition includes the following countries: all Western Europe except Malta and Turkey; in Eastern Europe, all former Warsaw Pact members (including Czechoslovakia's successors and Russia) except Bulgaria, Romania, and the successor states to the Soviet Union other than Russia; in East Asia, Japan, Singapore, South Korea, and Taiwan; in Oceania, Australia and New Zealand; and Israel and South Africa. The specific countries in each region classed as developed are so designated in Main Statistical Table III (pages ? - ?).

All other countries are classified as *developing*. Besides the newly independent and transitioning economies except Russia coming out of the Soviet Union and Yugoslavia, this developing group includes: the other recently or presently communist countries of Albania, Bulgaria, Cambodia, Mainland China, Cuba, Laos, Mongolia, North Korea, Romania, and Vietnam; all coun-

¹ The UN member countries as of 1997 not covered are Andorra, Antigua and Barbuda, the Bahamas, Comoros, Dominica, Grenada, Liechtenstein, Maldives, Marshall Islands, Micronesia, Monaco, Montserrat, Palau, Saint Christopher and Nevis, Saint Lucia, Saint Vincent and the Grenadines, San Marino, Seychelles, Solomon Islands, Vanuatu, and Western Samoa. Also omitted are: non-member countries Kiribati, Nauru, Tonga, and The Holy See; the territory with unresolved sovereignty of Western Sahara; the dependencies and areas of special sovereignty of Bermuda, Hong Kong, Macau, Puerto Rico, and numerous others, many being very small islands in the Atlantic and Pacific Oceans.

tries in: Africa except South Africa, Central Asia and Caucasus, Central America and the Caribbean, South America, South Asia, and the Middle East except Israel; the rest of East Asia other than Japan, Singapore, South Korea, and China--Taiwan; Fiji and Papua New Guinea in Oceania; and Malta and Turkey in Western Europe.

Most of the data are for calendar years. For some countries, however, expenditure data are available only for fiscal years which diverge from calendar years. In such cases, the fiscal year which contains the most months of a given calendar year is assigned to that year; e.g., data for the fiscal year April 1994 through March 1995 would be shown under 1994. Data for fiscal years ending on June 30 are normally entered under the calendar year in which they end.

Sources and Definitions

Military Expenditures

For **NATO countries**, military expenditures are from NATO publications and are based on the NATO definition. In this definition, (a) civilian-type expenditures of the defense ministry are excluded and military-type expenditures of other ministries are included; (b) grant military assistance is included in the expenditures of the donor country; and (c) purchases of military equipment for credit are included at the time the debt is incurred, not at the time of payment.

For **other non-communist countries**, data are generally the expenditures of the ministry of defense. When these are known to include the costs of internal security, an attempt is made to remove these expenditures. A wide variety of data sources is used for these countries, including the publications and data resources of other US government agencies, standardized reporting to the United Nations by country, and other international sources.

It should be recognized by users of the statistical tables that **the military expenditure data are of uneven accuracy and completeness**. For example, there are indications or reasons to believe that the military expenditures reported by some countries consist mainly or entirely of recurring or operating expenditures and omit all or most capital expenditures, including arms purchases. In the case of several countries (**Algeria, Chile, Cuba, Ecuador, Egypt, Indonesia, Iraq, Iran, Libya, Nigeria, and Syria**), special note of this possibility is made in Table I.

In some of these cases (as indicated in the footnotes of Table I), it is believed that a better estimate of total military expenditures is obtained by adding to nominal military

expenditures the value of arms imports (as shown in Table II and converted to local currency by current exchange rates). It must be cautioned, however, that this method may over- or underestimate the actual expenditures in a given year due to the fact that payment for arms may not coincide in time with deliveries, which the data in Table II reflect. Also, arms acquisitions in some cases may be financed by, or consist of grants from, other countries.

In Main Statistical Table I, the symbol “**E**” denotes rough estimates such as those described above and others made on the basis of partial or uncertain data. In a few cases of particular interest, even very rough estimates are shown, marked with the symbol “**R**”. It should be understood that these estimates are based on scant information and are subject to a wide range of error.

For countries with major clandestine nuclear or other military weapons development programs, such as Iraq, estimation of military expenditures is extremely difficult and especially subject to errors of underestimation.

Further improvements in the quality of the military expenditure data presented for countries throughout the world will be difficult to achieve without better reporting by the countries themselves. As has been noted elsewhere, “There is growing evidence that important amounts of security expenditures may not enter the accounts or the national budgets of many developing countries.”² Among the mechanisms commonly used to obscure such expenditures are: double-bookkeeping, use of extra-budgetary accounts, highly aggregated budget categories, military assistance, and manipulation of foreign exchange.

Particular problems arise in estimating the military expenditures of communist countries due to the exceptional scarcity and ambiguity of released information. As in past editions of this publication, data on the military expenditures of the **Soviet Union** are based on Central Intelligence Agency (CIA) estimates. For most of the series, these are estimates of what it would cost in the United States in dollars to develop, procure, staff, and operate a military force similar to that of the Soviet Union.³ Estimates of this type—that is, those based entirely on one country’s price pattern only—generally overstate the relative size of the second country’s expenditures in inter-country compar-

² Nicole Ball, “Measuring Third World Security Expenditure: A Research Note,” *World Development*, February 1984, pp. 157-164 (Pergamon Press, London).

³ See CIA, *Soviet and US Defense Activities, 1971-80: A Dollar Cost Comparison*, January 1981. The CIA dollar estimates as shown in this source have been updated and augmented by estimated retirement pay at US rates in order to improve comparability with expenditures by NATO countries, which include retirement pay.

isons, as is recognized by most experts. Also, such estimates are not consistent with the methods used here for converting other countries' expenditures into dollars.⁴

Nevertheless, the basic CIA estimates are the best available for present purposes; in fact, there are no alternative estimates that can inspire confidence and have the capability to detect relatively small changes over time, such as the slowdown and decline in Soviet military spending that the CIA estimates have indicated. Soviet estimates for the most recent years are based on the change in the index of CIA's estimated military expenditures in ruble terms, as reported in the Joint Economic Committee of Congress series, *Allocation of Resources in the Soviet Union and China*, *op. cit.*

For **Russia**, military spending estimates are revised downward from previous editions. The present estimates are based on the analysis of Professor Julian Cooper⁵. In view of the many uncertainties remaining in Russia's military spending as outlined by Cooper, these estimates must be considered very rough. Their full comparability to estimates for the Soviet Union is also uncertain.

For **former Warsaw Pact countries** other than the Soviet Union, the estimates of military expenditures through 1989 are from Thad P. Alton *et al.*⁶ These estimates cover the officially announced state budget expenditures on national defense and thus understate total military expenditures to the extent of possible defense outlays by non-defense agencies of the central government, local governments, and economic enterprises. Possible subsidization of military procurement may also cause understatement. The dollar estimates were derived by calculating pay and allowances at the current full US average rates for officers

and for lower ranks. After subtraction of pay and allowances, the remainder of the official defense budgets in national currencies was converted into dollars at overall rates based on comparisons of the various countries' GNPs expressed in dollars and in national currencies. The rates are based in part on the purchasing power parities (PPPs) estimated by the International Comparison Project of the United Nations, including their latest (Phase V) versions.

Estimates for these countries in 1990 and 1991 are based on total military spending in national currency as reported by the respective governments to the UN (in most cases) or the IMF. These expenditures in toto are converted to dollars at the Alton GNP conversion rates for 1989 as adjusted to 1991 by the respective US and national GNP deflators (per the World Bank), without estimating personnel compensation separately at US dollar rates, as was done for earlier years. The resulting military conversion rates (in national currency per dollar) are substantially higher than the implied rates for previous years, substantially lower than the 1991 market rate, and approximately the same as the implied rate for GNP (see below).

Estimates for the **newly independent states of the former Soviet Union, Yugoslavia, and Czechoslovakia** and other former Warsaw Pact countries present difficulties due to scarcity of reliable data in national currencies and to problems in converting to dollars. The basic method employed for most of these countries was to establish the ratio of military expenditures to GNP in national currency and then to multiply this ratio by the World Bank's estimate of GNP in dollars as converted to international dollars by estimated PPPs and reported in the *World Bank Atlas 1997*. This method implicitly converts military spending at the GNP-wide PPP, which, as with conversion by exchange rates, preserves the same ME/GNP ratio in dollars as obtains in national currency.

Data for **China** are based on US Government estimates of the yuan costs of Chinese forces, weapons, programs, and activities.⁷ Costs in yuan are here converted to dollars using the same estimated conversion rate as used for GNP (see below). Due to the exceptional difficulties in both estimating yuan costs and converting them to dollars, comparisons of Chinese military spending with other data should be treated as having a wide margin of error.

Other published sources used include the *Government Finance Statistics Yearbook*, issued by the

⁴ An alternative series employing the same basic data but reflecting both the US and Soviet price patterns was provided in previous editions of this publication. See table captioned "Alternative Estimates of Soviet Military Expenditures," *World Military Expenditures and Arms Transfers 1969-1978*, p.27; and the essay, "Soviet Military Expenditures," *World Military Expenditures and Arms Transfers 1968-1977*, pp. 13-19.

⁵ Julian Cooper, "The military expenditures of the USSR and the Russian Federation, 1987-97", in *SIPRI Yearbook 1998*, Stockholm International Peace Research Institute, 1998, pp.243-259. Rough estimates were made to supplement the Cooper estimates where recognized gaps were left unfilled. Conversion to dollars was at an estimated purchasing power parity (see Conversion ..., below).

⁶ The estimates are updates and substantial revisions of those in their article, "East European Military Expenditures, 1965-1978," (published in the Joint Economic Committee of Congress Compendium, *East European Economic Assessment*, Part 2, July 10, 1981, pp. 409-433) and particularly in their most recent Occasional Papers, Nos. 115-119 (published by the Research Project on National Income in East Central Europe).

⁷ Edward P. Parris, *Chinese Estimated Expenditures, 1967-83*. (Defense Intelligence Agency), November 1984. See also the series of Hearings before the Subcommittee on Priorities and Economy in Government of the Joint Economic Committee, US Congress, "Allocation of Resources in the Soviet Union and China," *op. cit.*

International Monetary Fund; *The World Factbook*, produced annually by the Central Intelligence Agency; *The Military Balance*, issued by the International Institute for Strategic Studies (London); and the *SIPRI Yearbook: World Armaments and Disarmament*, issued by the Stockholm International Peace Research Institute.

For the benefit of users concerned with accuracy, table entries based on inadequate data and/or simplistic methods and yielding approximative estimates that are not fully comparable with those for earlier years are marked “R” for “rough estimate”.

Gross National Product (GNP)

GNP represents the total output of goods and services produced by residents of a country, valued at market prices. The source of GNP data for most non-communist countries is the International Bank for Reconstruction and Development (World Bank).

For a number of countries whose GNP is dominated by oil exports (**Bahrain, Kuwait, Libya, Oman, Qatar, Saudi Arabia, and the United Arab Emirates**), the World Bank’s estimate of deflated (or constant price) GNP in domestic currency tends to understate increases in the monetary value of oil exports, and thus of GNP, resulting from oil price increases. These World Bank estimates are designed to measure real (or physical) product. An alternative estimate of constant-price GNP was therefore obtained using the implicit price deflator⁸ for US GNP (for lack of a better national deflator). This is considered appropriate because a large share of the GNP of these countries is realized in US dollars.

GNP estimates of the **Soviet Union** are by the CIA, as published in its *Handbook of Economic Statistics 1990* and updated. GNP estimates for **other Warsaw Pact countries through 1989** are from “East European Military Expenditures, 1965-1978” by Thad P. Alton and others, *op. cit.*, as updated and substantially revised by the authors. These estimates through 1989 have been extended to 1990 and 1991 on the basis of estimates for those years in the CIA’s *Handbook of Economic Statistics, 1992*.

Estimates of GNP in 1992-1994 for **successor states to the Soviet Union, Yugoslavia, and Czechoslovakia** are based on World Bank estimates, as published in *World Development Indicators 1999*.

GNP data for **China** are based on World Bank estimates in yuan. These are in line with estimates of GDP in

Western accounting terms made by Chinese authorities. Converting estimates in yuan to dollars is highly problematic, however, due to the inappropriateness of the official exchange rate and lack of sufficient yuan price information by which to reliably estimate PPPs. (The ratio of the highest to the lowest estimates by various sources of China’s GNP is on the order of 6 or 7 to 1, which would make the world rank of China’s GNP vary between about 3rd or 4th and 12th.) The conversion rate used here is based on a PPP estimated for 1981⁹ and moved by respective US and China implicit GNP deflators to 1994.

GNP estimates for a few non-communist countries are from the CIA’s *Handbook of Economic Statistics* cited above. Estimates for the other communist countries are rough approximations.

Military Expenditures-to-GNP Ratio

It should be noted that the meaning of the ratio of military expenditures to GNP, shown in Table I, differs somewhat between most communist (or previously communist) and other countries. For non-communist countries, both military expenditures and GNP are converted from the national currency unit to dollars at the same exchange rate; consequently, the ratio of military expenditures to GNP is the same in dollars as in the national currency and reflects national relative prices. For communist countries, however, military expenditures and GNP are converted differently. Soviet military expenditures, as already noted, are estimated in a way designed to show the cost of the Soviet armed forces in US prices, as if purchased in this country. On the other hand, the Soviet GNP estimates used here are designed to show average relative size when both US and Soviet GNP are valued and compared at both dollar and ruble prices. The Soviet ratio of military expenditures to GNP in ruble terms, the preferred method of comparison, is estimated to have been 15-18% in that country’s latest years.

For **Eastern European countries before 1992**, the ratios of military expenditures to GNP in dollars were about twice the ratios that would obtain in domestic currencies. (See Alton and others, *op. cit.*) However, since official military budgets in these countries probably substantially understated their actual military expenditures, the larger ratios based on dollar estimates are believed to be the better approximations of the actual ratios.

⁹ Jeffrey R. Taylor, *Dollar Estimates for China*, Center for International Research Staff Paper No. 59, US Bureau of the Census, March 1991. This PPP appears to be carefully constructed from detailed Chinese data and yields an intermediate result. When moved to 1993, this parity (1.293 yuan/dollar) is used to produce dollar values in the same manner as the 1993 exchange rate for other countries. (See below, Conversion of National Currencies to Dollars.)

⁸ The implicit price deflator is the ratio of GNP in current prices to GNP in constant prices.

Central Government Expenditures (CGE)

These expenditures include current and capital (developmental) expenditures plus net lending to government enterprises by central (or federal) governments. A major source is the International Monetary Fund's *Government Finance Statistics Yearbook*. The category used here is "Total Expenditures and Lending minus Repayment, Consolidated Central Government".

Other sources for these data are the International Monetary Fund, *International Financial Statistics* (monthly); OECD, *Economic Surveys*; and CIA, *The World Factbook* (annual). Data for Warsaw Pact countries are from national publications and are supplied by Thad P. Alton and others. For all Warsaw Pact countries and China, conversion to dollars is at the implicit rates used for calculating dollar estimates of GNP.

For all countries, with the same exceptions as noted above for the military expenditures-to-GNP ratio, military expenditures and central government expenditures are converted to dollars at the same rate; the ratio of the two variables is thus the same in dollars as in national currency.

It should be noted that for the **Soviet Union, China, Iran, Jordan, and possibly others**, the ratio of military expenditures to central government expenditures may be overstated, inasmuch as the estimate for military expenditures is obtained at least in part independently of nominal budget or government expenditure data, and it is possible that not all estimated military expenditures pass through the nominal central government budget.

Population

Population estimates are for midyear and are taken from the website of the US Bureau of the Census.

Armed Forces

Armed forces refer to active-duty military personnel, including paramilitary if those forces resemble regular units in their organization, equipment, training, or mission. Reserve forces are not included unless specifically noted.

Figures for the **United States** and all **other NATO countries** are as reported by NATO. Estimates of the number of personnel under arms for other countries are based on a variety of US Government and other sources, including *Jane's World Armies* and the IISS's *Military Balance*. The armed forces series for the **Soviet Union** includes all special

forces judged to have national security missions (e.g., KGB border guards) and excludes uniformed forces primarily performing noncombatant services (construction, railroad, civil defense, and internal security troops).

Arms Transfers

Arms transfers (arms imports and exports) represent the international transfer (under terms of grant, credit, barter, or cash) of military equipment, usually referred to as "conventional," including weapons of war, parts thereof, ammunition, support equipment, and other commodities designed for military use. Among the items included are tactical guided missiles and rockets, military aircraft, naval vessels, armored and nonarmored military vehicles, communications and electronic equipment, artillery, infantry weapons, small arms, ammunition, other ordnance, parachutes, and uniforms. Dual use equipment, which can have application in both military and civilian sectors, is included when its primary mission is identified as military. The building of defense production facilities and licensing fees paid as royalties for the production of military equipment are included when they are contained in military transfer agreements. There have been no international transfers of purely strategic weaponry. Military services such as training, supply operations, equipment repair, technical assistance, and construction are included where data are available. Excluded are foodstuffs, medical equipment, petroleum products and other supplies.

The statistics contained in Main Tables II, III and part of IV are estimates of the value of goods actually delivered during the reference year, in contrast both to payments and the value of programs, agreements, contracts, or orders concluded during the period, which are expected to result in future deliveries. However, summary data on arms transfer agreements are presented in part of Table IV. Both deliveries and agreements data represent arms transfers to governments and do not include the value of arms obtained by subnational groups.

US arms exports include both government-to-government transfers under the Foreign Military Sales (FMS), Military Assistance Program (MAP), and other programs administered by the Department of Defense, and commercial exports (enterprise-to-government or enterprise) licensed by the Department of State under International Traffic in Arms Regulations.

Data on US arms exports are for fiscal years as reported by the Departments of Defense and State. Data on US arms export agreements shown in Table IV have the same coverage as deliveries data.

Revisions of US arms export data have taken place in recent editions. Beginning in *WMEAT 1997*, the commercial arms exports component has been estimated by a new interim method, due to the growing incompleteness of the previous data series, and pending the availability of a new and more reliable series expected in the near future.

The estimating method is based on the value of approved commercial arms export licenses and agreements issued by the Department of State. It assumes that a medial 50 percent of approved license value results in *actual deliveries* and distributes the estimated deliveries over the life of the license. The method results in a substantial upward revision of the commercial component and the total export series.

The commercial component of US *agreements* data was also revised—it now includes the full value of approved export licenses and manufacturing and technical assistance agreements. Previously it had been assumed that commercial agreements were equal to deliveries.

(For further discussion, see the article, "*Revision of US Arms Export Series*" in *WMEAT 1997*, available on a Department of State website whose address may be found above in the Preface.)

The scope of US arms exports data was also modified in the *WMEAT 1995* edition. Under the previous practice, the materiel component (arms, equipment, and "hardware" items) of FMS and MAP sales was included, while the military services component was excluded (although the magnitude and general destination of the omitted services was reported in these Statistical Notes). The commercial sales category, which covers both military materiel and military services, was included in its entirety.

With the modification, both the materiel and the military services components of FMS and other government-to-government sales (such as the International Military Education and Training Program—IMET) are included in total US arms exports as reported here.

The omission of FMS and other military services prior to the previous edition had been intended to improve comparability with available estimates of the arms exports of other countries, which tended to contain a much smaller services component and/or were subject to significant underestimation (services being less easily determined). The increasing importance of these services generally and the desire to present a full picture of US arms exports consistent with other sources prompted the change to inclusion. Users should be aware, however, of both the lower true share of services in other countries' arms exports and a possible tendency to underestimate them. It should also be

noted that a portion of the IMET program is devoted to programs that promote improved civil-military relations.

The change in scope of US arms exports increased their overall volume by amounts ranging over the last decade from \$2.3 billion (current dollars) to \$3.7 billion for deliveries and \$2.3 billion to \$7.3 billion for agreements.

US arms imports data are obtained from the Department of Commerce, Bureau of Economic Analysis (BEA), and include (a) imports of military-type (formerly "special category") goods, as compiled by the Bureau of the Census, and (b) Department of Defense direct expenditures abroad for major equipment, as compiled from DOD data by BEA. The goods in (a) include: complete military aircraft, all types; engines and turbines for military aircraft; military trucks, armored vehicles, etc.; military (naval) ships and boats; tanks, artillery, missiles, guns, and ammunition; military apparel and footwear; and other military goods, equipment, and parts.

Data on **countries other than the United States** are estimates by US Government sources. Arms transfer data for the Soviet Union and other former communist countries are approximations based on limited information.¹⁰

It should be noted that the arms transfer estimates for the most recent year, and to a lesser extent for several preceding years, tend to be understated. This applies to both foreign and US arms exports. Information on transfers comes from a variety of sources and is sometimes acquired and processed with a considerable time lag. Data for the most recent two years in Main Statistical Tables II, III, and IV therefore can be expected to undergo some upward revision in succeeding editions.

Close comparisons between the estimated values shown for arms transfers and for GNP and military expenditures are not warranted. Frequently, weapons prices do not reflect true production costs. Furthermore, much of the international arms trade involves offset or barter arrangements, multiyear loans, discounted prices, third party payments, and partial debt forgiveness. Acquisition of armaments thus may not [necessarily] impose the burden on an economy, whether in the same or in other years, that is implied by the estimated equivalent US dollar value of the shipment. Therefore, the value of arms imports should be compared to other categories of data with care.

¹⁰ Soviet arms transfers and foreign trade data are taken from sources that present them directly in dollars; hence, particular caution should be used in comparing these statistics for arms transfers and foreign trade with other Soviet data.

Total Imports and Exports

The values for imports and exports cover merchandise transactions and come mainly from International Financial Statistics published by the IMF. The trade figures for presently and formerly communist countries are from the CIA's *Handbook of Economic Statistics*.

Estimates for "NAs"

The "NA" entries in the Main Statistical Tables for a given country/variable/year signify that data considered sufficiently valid and reliable for presentation as such is not available. However, in all such cases, a rough or approximate estimate has been made and is used in aggregative estimates for the world, region, or other country group. This is done in order that the absence of data for a given country/year/variable not distort group totals unduly, and to permit the inclusion of the country in a ranking. Such "fill" estimates are based on a variety of grounds, such as available fragmentary information, previous trends, or assumptions as to the relationships between known and unknown variables.

Conversion of National Currencies to Dollars

All value data in the report are expressed in US dollars. For most countries, this requires the conversion into dollars of amounts expressed in national currencies at current (or "then-year") prices. Available methods for doing so are less than satisfactory in all respects. The approach adopted in this series of reports relies on market or par exchange rates. In this method, current-price national currency data for an entire series of years is converted to current US dollars through the use of a single (base-year) exchange rate, a national price indexes, one and one US.

Basic Steps

The conversion approach used here consists essentially of three steps:

- Each country's data, expressed originally in the national currency and at current prices, are "deflated" or put into constant-price terms, usually by means of the country's implicit deflator for GNP as a whole. This GNP price index is used also for other variables—military and central government expenditures—because more appropriate price indices for those sectors are not generally available. National currency data for all years are expressed in prices of the conversion base year (1997 in this issue).
- These data are then divided by the average exchange rate in the base year between the national currency and the US dollar and thus converted into constant base-

year (1997) dollars. Exchange rates are provided by the World Bank and are usually the annual average par/market rate, (the "rf" rate as designated by the International Monetary Fund).

- Data in constant dollars are then expressed in current dollars by multiplying by the US implicit GNP deflator.

The calculation may be illustrated by an example, assuming the following data:

1987 national military expenditures, in national currency at current (1987) prices.....4,600

1987 implicit GNP deflators (1997 = 100):

National.....55.5

US.....77.7

1997 exchange rate, national currency units

per dollar.....15.92

Then, 1987 national military expenditures:

In constant 1997 dollars = $4,600 \div .555 \div 15.92 = 520.6$

In current (1987) dollars = $520.6 \times .777 = 404.5$

Advantages and Disadvantages

The use in this report of the same rate for converting all variables from national currencies to US dollars (with the exceptions noted below) means that the relationships among variables in national currency terms remain the same when those variables are expressed in dollars.

The conversion method used here has an advantage in that it takes into account national differences in the behavior of prices and, within each edition, avoids the distorting effect that can result from changes in exchange rates during the decade. It does not, however, allow for a number of other factors. One is that any within-country differences between the price indices for military or central government expenditures and for GNP are not taken into account. For example, indices for compensation of military personnel or prices of imported arms might behave differently from the overall index.

A more serious problem is that exchange rates in many cases do not adequately reflect the relative purchasing

¹¹ These PPPs have been estimated by the United Nations International Comparisons Project, a cooperative undertaking of the United Nations, the World Bank, and the University of Pennsylvania. See Irving Kravis, Alan Heston, and Robert Summers, *World Product and Income: International Comparisons of Real Gross Product*, published for the World Bank by the Johns Hopkins University Press, Baltimore and London, 1982.

power of currencies. This has been demonstrated by a detailed study of purchasing power parities (PPPs) for the GNPs of a large number of countries.¹¹ This study found that the greater the disparity in the per capita income of countries, the greater the tendency for exchange rates to understate the value of the poorer country's product, and that the understatement can be very large, reaching as much as threefold in some cases. However, since this study did not estimate PPPs for military expenditures as such, it does not shed much light on how PPPs specific to military expenditures or arms purchases might differ from exchange rates or from either overall or other sector-specific PPPs.¹²

A disadvantage of the method used here in WMEAT is that the resulting conversion to current dollars for a given year can vary from edition to edition, despite the absence of any change in data for that year itself. The change is due solely to the rolling up of the exchange rate base year so as to make it more up-to-date, which usually means a change in the exchange rate used.

Such changes have been exceptionally large and frequent recently. This was due to two major factors: (1) the change from an appreciating and overvalued US dollar (until 1985) to a depreciating one and (2) the very high inflation rates and concomitantly large exchange rate movements occurring in a number of developing countries, together with the tendency of the exchange rate changes to undercompensate or overcompensate for relative price movements.

For a discussion of the extent of the changes and their impact on inter-country comparisons and group averages, see *WMEAT 1988*, pp. 135-136. The changes in exchange rates have not been as extensive in recent years, except for the growing number of high inflation countries.

Exceptions

There are several exceptions to the general conversion procedures discussed above. Data on arms transfers in value terms for all countries obtained by this Agency are already expressed in current dollars. (Original data in foreign currencies have generally been converted by the source at current exchange rates.) These current dollars are converted to constant 1997 dollars in the manner shown above. For the Soviet Union, GNP estimates in rubles are converted by the source into constant dollars at what is in effect an

average US-and-Soviet-weighted PPP for GNP as a whole. This same conversion rate is also used for Soviet central government expenditures. Soviet military expenditures are in effect converted by the source at a military-sector PPP using only Soviet weights. (See also the discussion of Military Expenditures, above).

For other Warsaw Pact countries prior to 1992, the available estimates for GNP and military expenditures are also already in terms that accounted for domestic price changes and have been converted to constant dollars using estimated purchasing power parities, rather than official exchange rates.

For successor states to the Soviet Union, Yugoslavia, and Czechoslovakia, other former Warsaw Pact countries, and China, GNP and other variables in national currencies are converted at PPP's, usually as estimated and published by the World Bank in its *World Development Indicators*.

It should be noted that in all cases the relationship between current and constant dollars in this report is determined entirely by the US GNP deflator index. To facilitate reconversion to other constant-dollar bases if desired, this index, rebased here to 1997=100, is as follows:

1987	76.54	1992	90.20
1988	79.12	1993	92.61
1989	82.17	1994	94.56
1990	85.39	1995	96.58
1991	88.28	1996	98.36

Growth Rates

The average annual rates of real growth shown in Tables 1-5 of the Highlights are based on data in constant 1997 dollars from Main Tables I and II. The rates are calculated by a least-squares fit to all years of the period of the log form (to the base 10) of the following "compound interest" equation:

$$Y = A(1 + R/100)^T,$$

or

$$\text{Log} Y = \text{Log} A + \text{Log}(1 + R/100) \times T,$$

where Y is military expenditures (or other variable) in a given year, A is the initial value for year 0, T is time in years, and R is the growth rate in percent.

This formula was used in all cases to provide a consistent measure of change and is not intended to provide the best fit for projection purposes.

¹² A United Nations expert group has studied the feasibility of constructing purchasing power parities and price indices for military expenditures (A/40/421, 13 August 1985). However, practical prospects for the future availability of usable military PPPs are poor due to the lack of underlying national data, especially on military prices.